Remarks

In addition to the remarks already submitted, Applicant submits herewith an Information Disclosure Statement submitting GB 2215032 to Shin ("Shin"), and the following arguments.

The lower density of F-T fuels

Claims 1-76 are cancelled and new claims 77-102 are added.

The new claims specify feeding to a yellow flame burner one or more liquid Fischer Tropsch product, or a blend comprising one or more liquid Fischer Tropsch product, "having a density of between 0.65 and 0.8 g/cm^3 at 15° C." As explained in the specification, "[a]s a result of the low content[] of aromatics and naphthenic[] compounds the density of the Fischer-Tropsch product will be lower than the conventional mineral derived fuels. The density will be between 0.65 and 0.8 g/cm^3 at 15° C." U.S. Patent Publication 2005/0255416, ¶ [0017]. See also Table 1, where the tested fuels had the following densities:

Fuel	Density (kg/m^3 at 15 °C)
Fischer Tropsch Kerosene (Oil A)	734.8
Fischer Tropsch gas oil (Oil B)	785.2
Ultra low sulphur gas oil (Oil D)	846.3
Industrial gas oil (Oil C)	854.3

The density of both of the petroleum derived gas oils in Table 1 was at least 60 kg/m^3 at 15 °C greater than the Fischer-Tropsch products.

The examiner cannot point to any teaching or suggestion in any cited reference or elsewhere that the claimed liquid Fischer-Tropsch products "having a density between 0.65 and 0.8 g/cm^3 at 15 °C" would be effective fuels for operating a blue flame burner. The examiner cannot point to any teaching or suggestion in the cited references that the claimed lower density liquid Fischer-Tropsch products (or blends) would effectively vaporize and/or atomize to form an effective spray for combustion by a blue flame burner. The examiner cannot point to any teaching or suggestion that the claimed low density liquid Fischer Tropsch products would ignite and burn under the conditions produced by a blue flame burner. The examiner cannot point to a teaching or suggestion regarding whether a blue flame burner burning the claimed low density liquid Fischer-

Tropsch products would produce a stable flame over time. Nor can the examiner point to a teaching or suggestion whether a blue flame burner burning these low density liquid Fischer-Tropsch products would form deposits that could impact a number of things, including emissions.

The examiner certainly cannot point to a teaching or suggestion that these lower density liquid Fischer Tropsch products could be used in a blue flame burner for direct heating of large spaces. As explained in the specification:

> Normally gaseous fuels for example natural gas, LPG and the like, are used for this application because the associated flue gasses can be safely supplied to said space. A disadvantage of the use of gaseous fuels is however that handling of the pressurized gas containers and combustion equipment requires professional skills in order to operate such an apparatus safely. By using a Fischer-Tropsch derived liquid fuel a comparable flue gas is obtained in the blue flame burner as when a gaseous fuel is used. Thus a method is provided wherein a liquid fuel can be applied for direct heating of spaces. The application of the liquid Fischer-Tropsch derived fuel makes the use of the apparatus for direct heating much more simple and safe.

Publication 2005/0255416 ¶ [0014]. The examiner simply cannot point to a teaching or suggestion in the cited references to feed one or more liquid Fischer-Tropsch product "having a density between 0.65 and 0.8 g/cm^3 at 15 °C" to a blue flame burner for direct heating of large spaces.

The examiner attempts to meet his burden by pointing to several references related to diesel fuels comprising Fischer-Tropsch products used to **operate automotive engines**. However, the fuel in an automotive engine is ignited and burned in an entirely different fashion than fuel fed to a blue flame burner.

Burning of fuel in a blue flame burner is described in the specification as follows:

> Conventional designs of oil burner assemblies for home heating fuel oils employ a traditional fuel/air mixing process in which the evaporation and combustion of the fuel oil take place simultaneously. In one form of oil burner assembly for home heating fuel oils the fuel oil is sprayed as a hollow cone and air is weakly swirled along a path which is parallel to the axis of a burner blast tube and which passes into the hollow cone so that the trajectories of the fuel oil droplets cross the air flow streamlines. This leads to a rapid evaporation giving fuel oil rich regions, which in turn ignite under local sub-stoichiometric conditions producing soot, and results in air pollution as well as well as a waste of a fossil fuel.

> The general pattern of the flame of such an oil burner assembly is one of heterogeneity in terms of fuel concentrations; the pockets of fuel lean mixture give rise to high nitric oxide concentrations from both the fuel nitrogen and the atmospheric nitrogen, while the pockets of fuel rich mixture give rise to soot. The visible flame from such a system is yellow. The yellow colour is the visible radiation from the high temperature soot particles and this completely masks other visible radiations as far as the human eye is concerned. These soot particles result from non-burnt carbon.
>
> For complete combustion of the carbon, that is soot-free combustion, the step-wise combustion of carbon to carbon dioxide via the intermediate carbon monoxide stage gives rise to a visible radiation in the blue region of the light spectrum. When this occurs the blue radiation becomes visible in a soot-free or low-luminosity flame, and oil burners for such soot-free flames are known as blue flame burners.

US Publication No. 2005/0255416, ¶ [0002]-[0003].

Even if diesel fuel is burned for purposes of domestic heating in some markets, GB 2215032 A (Shin) establishes that diesel fuels have high ignition points that require preheating and/or special hardware in order for a "gasifying stove" to completely combust the diesel fuel:

> It is found that most fuels for gasifying stoves are kerosene and Diesel fuel oil which are of high igniting point. Hence, in order to cause the fuel to be burned easily, it is commonly suggested to set a **preheating procedure** so that the fuel will be heated prior to its gasification thereby helping to combust [] the fuel. **However, the temperature increase[] in such preheating procedure is often insufficient to cause a complete combustion, thus wasting fuel, lowering the efficiency as well as polluting the environment.**

Shin, p. 1, ll. 4-17 (emphasis added).

The claims specify feeding the one or more lower density liquid Fischer Tropsch product or blend to a blue flame burner **"adapted to burn petroleum derived gas oil."** Shin establishes that, because of their high igniting points, diesel fuels require preheating or special hardware in order to be completely combusted by "gasifying stoves." Using the examiner's own reasoning, Shin weighs against a finding that the claimed method would have been obvious.

The examiner cannot point to a teaching or suggestion to feed diesel fuel to a blue flame burner **adapted to burn petroleum derived gas oil.** The examiner clearly cannot point to a teaching or suggestion to feed diesel fuel **comprising the claimed one or**

more low density liquid Fischer Tropsch product to a blue flame burner to "perform[] one or more procedure selected from the group consisting of heating water by indirect heat exchange with the improved flue gas in one or more boiler and heating space directly with the improved flue gas." The examiner certainly cannot establish that "burning the one or more liquid Fischer-Tropsch product using the blue flame burner under conditions comprising a value of lambda of from about 1.05 to about 1.2 [would] produc[e] improved flue gas comprising 100 mg/kWh or less carbon monoxide and 150 mg/kWh or less NO_x at said value of lambda." Claims 39 and 42.

As the U.S. Supreme Court recently observed, "inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. ____ , 127 S.Ct. 1727, 82 U.S.P.Q.2d 1385, 1396 (U.S. 2007). For this reason, "**[a] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, *independently*, known in the prior art.**" *Id.* (emphasis added). The Federal Circuit recently reaffirmed that "**a flexible TSM [teaching-suggestion-motivation] test remains the primary guarantor against a non-statutory hindsight analysis.**" *Id.* at 11, citing *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

The examiner cannot point to a teaching or suggestion in the cited references of every element of the new claims, and cannot meet the flexible TSM test with respect to any of the new claims.

Applicant requests consideration and allowance of all of the pending claims.

-Near stoichiometry

New independent claims 97 and 100 specify "using the blue flame burner under conditions comprising a value of lambda of from about 1.05 to about 1.2." New independent claims 97 and 100 also specify "producing improved flue gas comprising 20 mg/kWh or less carbon monoxide and 100 mg/kWh or less NO_x"

The examiner cannot point to a teaching or suggestion of every limitation of new independent claims 97 and 100 in the cited references or elsewhere.

As explained in the specification:

Applicants found that by using a Fischer-Tropsch derived fuel a very low lambda of between 1.05 and 1.2 could be applied without large emissions of carbon monoxide as would be the case when Industrial Gas Oil would be used.

U.S. Publication No. 2005/02554419 ¶ [0012].

Operation of a blue flame burner is more efficient at a value of lambda that is at or near stoichiometric. Basically, combustion consumes oxygen and produces heat and exhaust gas comprising carbon dioxide and other components, depending upon the fuel. Unfortunately, at least some conventional fuel oils produce excessive carbon monoxide emissions at low lambdas. See the ultra low sulphur gas oil (Oil D) in Figure 3 (Example 1).

Applicants unexpectedly found that the amount of carbon monoxide in flue gas produced burning several Fischer Tropsch products at a lambda of about 1.1 or lower using a blue flame burner was consistently about 30 mg/kWh or less. See Figure 3 (Example 1).

Specifically, burning both a Fischer-Tropsch derived kerosene (Oil A) and a Fischer-Tropsch gas oil (Oil B) at a lambda of from about 1.1 to 1.2 produced flue gas with only about 20 mg/kWh of carbon monoxide. Burning a standard industrial gas oil (Oil C) and an ultra low sulphur gas oil (Oil D) at a lambda of about 1.1 using the blue flame burner produced flue gas with just over 20 mg/kWh carbon monoxide content. However, just below a lambda of 1.1, the carbon monoxide content jumped from just over 20 mg/kWh to over 50 mg/kWh for the standard gas oil (Oil C) and up to 80 mg/kWh for the ultra low sulfur gas oil (Oil D).

Also, the amount of NO_x in flue gas produced using a blue flame burner operating at a lambda of from about 1.1 to 1.2 burning the standard gas oil (Oil C) was approximately 180 mg/kWh and for the ultra low sulfur gas oil (Oil D) and over 120 mg/kWh compared to 100 mg/kWh or less burning the Fischer Tropsch kerosene (Oil A) and the Fischer-Tropsch gas oil (Oil B). Figure 2, Example 1.

The process of claims 97 and 100 provides near stoichiometric operation of a blue flame burner at a value of lambda of from about 1.05 to about 1.2 that consistently produces improved flue gas comprising 20 mg/kWh or less carbon monoxide and 100 mg/kWh or less NO_x.

The examiner cannot point to a teaching or suggestion in the cited references of every element of new independent claims 97 and 100, and cannot meet the flexible TSM test with respect to claims 97, 100, or claims depending therefrom.

Applicant respectfully requests entry and allowance of claims 97, 100, and claims depending therefrom

__New claims 92 and 93__

New claims 92 and 93 both specify "accurately detecting the flame over time using an ionization sensor."

As explained in U.S. Publication No. 2005/02554419 ¶ [0015] (emphasis added):

> Blue flame burners are often provided with a flame detector. Examples of suitable detectors are the UV sensors and IR sensors. **A more preferred detector is the so-called ionisation sensor.** An ionisation sensor is suitable to monitor burners with intermittent operation as well as continuous operation. The principle of operation of the ionisation flame monitor is based on the rectifying effect of a flame. If a flame is present, a current flows between the burner an the ionisation electrode. This ionisation current is evaluated by the flame monitor to determine if a flame is present. **In some prior art applications ionisation sensors could not be used in combination with a liquid fuel because deposits in the sensor led to false currents in the sensor. Because use of the Fischer-Tropsch derived fuel results in less deposits ionisation sensors can be applied.** This is an advantage because these sensors are more readily available than the IR or UV sensors.

The examiner cannot point to a teaching or suggestion of the foregoing additional limitation of new claims 92 and 93 in the cited references.

Applicant requests consideration and allowance of claims 92 and 93 for the foregoing additional reason.

__Shin and Chen are objective indicia of non-obviousness of the pending claims__

Applicant concedes that diesel fuel is used for domestic heating in some markets. However, Applicant submits that the description in Shin and Chen provides objective indicia that the pending claims are not obvious.

__**-Shin**__

Shin acknowledges that:

> It is found that most fuels for gasifying stoves are kerosene and Diesel fuel oil which are of high igniting point. Hence, in order to cause the fuel to be burned easily, it is commonly suggested to set a preheating procedure so that the fuel will be heated prior to its gasification thereby helping to combust [] the fuel. **However, the temperature increase[] in such preheating procedure is often insufficient to cause a complete combustion, thus wasting fuel, lowering the efficiency as well as polluting the environment.**

Shin, p. 1, ll. 4-17 (emphasis added).

Shin acknowledges the problem that fuels used in "gasifying stoves" are guilty of "polluting the environment." Nevertheless, Shin does not teach or suggest feeding a diesel fuel comprising a *Fischer-Tropsch* product to the burner to solve this problem.

-Chen

Chen acknowledges that "requirements for low sulfur middle distillates, especially diesel fuel and **home heating** oil is expected to lead to **more stringent specifications for those products.**" Chen, col. 1, ll. 33-36 (emphasis added). Chen also clearly was aware that Fischer-Tropsch products existed. Chen states that suitable feeds for his process include "feeds from synthetic oil production processes such as Fischer-Tropsch synthesis" Chen, col. 6, ll. 17-22.

Nevertheless, **the examiner cannot point to any teaching or suggestion in Chen to use a Fischer Tropsch fuel as a component of a feed to a blue flame burner** ***in order to produce home heating oils that meet more stringent requirements.***

Of course, the examiner contends that he has pointed to just such a teaching or suggestion in Chen. However, Chen describes an integrated refining process for producing a large variety of products. Home heating oil is only one of a vast array of products that can be made using Chen's process.

Chen mentions that a Fischer Tropsch feed is one of several possible alternative feeds to Chen's "integrated refining process" to make this vast array of products. Chen's statement that a Fischer Tropsch product can be used as an alternate feed to Chen's integrated refining process **is not a teaching or suggestion to use one or more liquid Fischer Tropsch product having the claimed low density as a feed or as a component of a feed to a blue flame burner.**

-Shin and Chen are objective indicia that the
claimed solution to the problem was not obvious

The fact that the examiner cannot point to a teaching or suggestion in Shin or Chen of the claimed solution to this recognized problem is evidence that others confronted with the problem have failed to find the claimed solution to the problem. The examiner also cannot point to a reference teaching or suggesting the claimed solution the problem over the course of the 20 long years following the issuance of Shin and Chen. This is evidence of a long felt but unmet need, and is strong evidence that the claims are not obvious. *Graham* v. *John Deere Co. of Kansas City*, 383 U.S. 1, 17-18 (1966). *DyStar Textilfarben GmbH v. C.H. Patrick Co.,* 80 U.S.P.Q.2d 1641, 1645 (Fed. Cir. 2006).

CONCLUSION

For all of the foregoing reasons, Applicant respectfully requests entry of the new claims, and consideration and allowance of all of the new claims. . If the examiner finds the application other than in condition for allowance, the examiner is requested to call the undersigned attorney at the Houston, Texas telephone number (713) 334-5151 x 200 to discuss the steps necessary for placing the application in condition for allowance. The Commissioner is hereby authorized to charge any fees in connection with this paper, or to credit any overpayment, to Deposit Account No. **19-1800 (File No. TS8580)**, maintained by Shell Oil Company.

Respectfully submitted,

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